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U.S. DEPARTMENT OF AGRICULTURE

PESTICIDES and WILDLIFE

By Lucille F. Stickel and Paul F. Springer

Wildlife Biologists, Branch of Wildlife Research

Bureau of Sport Fisheries and Wildlife

Over 500 million dollars' worth of pesticides were produced for retail sale in the United States in 1956, seven times the volume of 1940. Production by 1975 is expected to exceed 2 billion dollars' worth annually. Farmers bought 60 percent of the 1956 total. The remainder, more than half a billion pounds, was purchased for non-farm use. Over 200 basic pesticides and more than 6,000 brand-named products are now on the market.

Much of the increase in pesticide production has been in chemicals not on the market before World War II. DDT was introduced first. It was soon followed by benzene hexachloride, aldrin, malathion, and others. In all, more than 60 effective new insecticides have been developed. Airplane treatments of large areas have increased in number and extent. As a result, insect control is now practiced on a larger scale than ever before in history.

Reports of damage to wildlife have followed many insecticidal operations. The invertebrate food supply of fish was severely damaged in certain DDT treatments of forested areas. Ducks began to die 32 hours after aldrin spraying in North Dakota. Mortality continued for 24 days. High wildlife mortality followed dieldrin treatments to control rice-leaf miner in California.

Questions of value and priority inevitably have arisen. Twenty-five million people in the United States depend on fishing and hunting for part of their recreation. A far greater number regularly use outdoor areas for camping, nature study, picnicking, and vacationing. Many of these people object to the wastage of wildlife. Users of insecticides reply that their programs are necessary. The controversy can not be settled by argument. Some studies are underway to determine the seriousness of the hazard to wildlife, and if possible to find dosages and methods of treatment that will minimize the danger. Much progress has been made, but many questions remain unanswered.

MARCH 3, 1849

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Washington 25, D. C.
Wildlife Leaflet 392

Alarmed at the increase in number of control programs and the use of more potent chemicals, many persons have written to the U. S. Fish and Wildlife Service asking about present and future effects on wildlife resources. This leaflet is designed to help answer these questions. It is arranged in question and answer form for easy reference.

Q. Just what are the "new pesticides"?

A. There are two main types of insecticides. DDT is an example of the group known as chlorinated hydrocarbons. Other chlorinated hydrocarbons are BHC (benzene hexachloride), lindane, toxaphene, TDE or DDD, methoxychlor, chlordane, heptachlor, aldrin, dieldrin, and endrin. Some chlorinated hydrocarbons are much more toxic than others, but they resemble each other in being chemically stable, which means that they remain poisonous for considerable lengths of time.

Members of the other group of insecticides are known as organic phosphates. Those in common use include malathion, parathion, methyl parathion, TEPP, EPN and demeton Newer materials that may or may not receive wider use are Diazinon, Guthion, Phosdrin, and Thimet. These chemicals vary in toxicity. Some are extremely poisonous to birds and mammals. In contrast to members of the first group, the organic phosphates break down and lose potency relatively quickly.

Still other groups of chemicals are used as herbicides for weed control, and as fungicides for protection against plant diseases.

Q. Why is it considered necessary to use these poisons at all?

A. Losses to insects, plant diseases, and weeds total about 11 billion dollars annually. Farmers constantly are seeking for ways to produce more and better crops; new chemicals that promise better pest control are in great demand. Increased public insistence on unblemished fruits and vegetables has encouraged farmers to expand their pesticidal programs. High labor costs are another factor that increases the use of pesticides, for large-scale treatments of crops by airplane or power sprayers are cheaper on a per-acre basis than small-scale manual treatments.

Non-agricultural use of pesticides also is increasing because of public pressures. Extensive programs for mosquito control and for protection of forest and shade trees have stimulated production and use of new pesticides

Q. Is there a serious threat to wildlife from the new chemicals?

A. Indiscriminate and improper use of pesticides can be a grave danger.

Permanent reductions in wildlife populations may very well result from increased use of powerful new materials. Many of these are applied several times in a season or remain toxic for long periods of time.

Q. In what ways may wildlife be damaged by chemical treatments?

A. Animals may be killed by contact with certain insecticides. They also may die as a result of eating insects, fish, or other animals that have been poisoned. Control operations against malaria mosquitoes on the island of Cyprus were successful, but they also destroyed most or all other species of aquatic invertebrates and all native freshwater fish.

Most public complaints arise from observations of dead animals. It is less well known that non-fatal doses of certain chemicals may cause reduced reproductive capacity and lowered survival of chicks in quail, pheasants, and probably in other birds.

In addition, depletion of the food supply may reduce the number of animals an area can support and so cause death or departure of a portion of the population.

Herbicides affect animals primarily by changing their environment. They can be beneficial or harmful depending on how they are used. Herbicide applications can destroy or change wildlife habitat enough to eliminate species of animals from an area.

Q. What can be done to reduce the danger?

A. The following principles are recommended:

(1) Be sure there is a real need for pesticide use.

(2) Consult with competent wildlife biologists before starting insecticidal programs.

(3) Select the chemical that will be the least dangerous and still do the job. The most specific chemical is generally best. State and federal control agencies are ready to advise on the best and safest chemicals. Apply chemicals strictly according to label instructions. Consider the liquid in which a pesticide is mixed as well as the pesticide itself; some carriers are toxic to wildlife.

(4) Use minimum dosages and minimum number of applications. Increased rates of application or extra treatments "for good measure" do not greatly increase insect control and do increase hazard to wildlife.

(5) Treat the minimum possible area. Serious effects are more likely to result from treatments over large areas. Avoid spraying in windy weather to prevent drift. Provide good ground-to-plane control in airplane spraying.

(6) When large areas are sprayed or dusted, leave blocks, strips or headwaters untreated at the first application whenever possible. This allows rapid repopulation of wildlife if damage occurs. These areas can be treated at a later time or in succeeding seasons if necessary.

(7) Plan the time of treatment to reduce hazards. If possible, avoid the main spring migration and nesting period of birds. To protect bees, apply insecticides in the evening and at times other than those of peak flowering.

(8) Prevent puddling of insecticidal solutions on the ground and in street gutters where birds and other animals may drink and bathe. Mist blowers (pictured on front cover) and foggers cause little or no puddling compared to hydraulic sprayers.

(9) Because of the sensitivity of fish and crabs to most insecticides, avoid, if possible, direct or indirect contamination of water. Be cautious about applying pesticides near streams and ponds if there is danger they will be washed in by rains. Do not fill or rinse spray equipment in these waters. Cover fish ponds and bird baths. If treatment is by plane, avoid using streams as boundaries of plots.

(10) If insecticides are used in emulsion form, use smaller quantities, because of their greater danger to many aquatic animals.

Q. Can the new chemicals be counted on to continue to control the pests against which they have been so effective?

A. Resistant populations of certain kinds of insects began to develop within a few years after extensive DDT treatments were begun. Many insects no longer can be controlled economically with DDT, regardless of the dosage used. Resistance to poisoning by DDT frequently means quick development of resistance to other chlorinated hydrocarbons. However, DDT still controls many insects effectively and is widely used.

Insects resistant to DDT and related compounds are still susceptible to the organic phosphates, and this accounts for the great recent popularity of this group. Already, though, there are examples of resistance to organic phosphates.

The boll weevil has become resistant to chlorinated hydrocarbons and the older calcium arsenate treatment is being recommended again.

Chemical control may backfire in another way. When orange groves in California were treated for control of citricola scale, these pests were reduced but so were many other insects. Among these was the vedalia beetle, which feeds on the cottony-cushion scale, another potentially serious pest. Before long there were widespread outbreaks of cottony-cushion scale, the first since 1890.

Application of DDT and some other chemicals to vegetable and fruit crops are frequently followed by heavy infestations of aphids and spider mites, whose natural enemies are destroyed. The aphids and mites sometimes are more destructive than the original pests.

Q. Is there any alternative to the use of more and more and stronger and stronger pesticides?

A. Yes. The best immediate, practical procedure is to follow the principles outlined on pages 3 and 4. Careful selection of the chemical is especially important. The most specific chemical and method of application is usually best, both for effective control and for prevention of wildlife damage.

For the future, research should be pressed immediately in two directions:

(1) Development of more specific chemicals and more specific methods of application.

(2) Development of biological and environmental controls. This includes development of plant varieties resistant to damage by insects and disease; encouragement of natural enemies of insects, such as birds, insect predators, and insect parasites; planting and harvesting of crops at the particular times that will be most effective in preventing insect attack; proper fertilization and rotation of crops to deter insect damage; destruction of insect wintering quarters; intelligent manipulation of water; and regulation of other biological and environmental factors to reduce insect nuisance.

Q. Is DDT a "safe" insecticide?

A. DDT was one of the earliest and most popular of the new insecticides, and its effects on wildlife are better known than those of the others. Relatively safe recommended dosages, carriers, and methods of application have been worked out. Injudicious use of DDT has been and can be dangerous to wildlife.

The following recommendations are made for the use of DDT in oil solution: To avoid damage to birds, amphibians, and mammals in forest areas, use no more than two pounds of DDT per acre in any one year. To avoid damage to fish, crabs, and crayfish, use no more than one-fifth pound of DDT per acre over water areas. If treatments are repeated several times in a season, use one-tenth pound, or less, per acre. Apply smaller quantities of emulsions, and reduce dosages 50 percent when ground-spray equipment is used. Problems and prevention of wildlife damage by DDT are discussed more fully in articles listed at the end of this leaflet.

Q. How do the other new insecticides compare with DDT in toxicity to wildlife and fish?

A. As a general rule, methoxychlor, TDE, BHC (containing 12-14 percent gamma isomer), and malathion, are less harmful to birds and mammals than is DDT. Toxaphene and chlordane are similar to DDT in effect. More lethal than DDT are lindane, heptachlor, aldrin, endrin, dieldrin, demeton, EPN, parathion, methyl parathion, TEPP, Diazinon, Guthion, Phosdrin and Thimet.

The order of susceptibility is somewhat different for fish. In general, TDE, BHC, methyl parathion, and TEPP are safer than DDT. Chlordane, methoxychlor, and DDT have approximately the same toxicity. Fish are more severely affected by endrin, dieldrin, toxaphene, lindane, aldrin, and malathion than by DDT. The effect of parathion depends on several factors; it is sometimes less and sometimes more toxic than DDT.

Little or no information is available on the hazards to wildlife and fish of most other new insecticides.

Q. Which insecticides offer the greatest potential danger to wildlife?

A. On the basis of present information, the chlorinated hydrocarbons are the greatest cause for concern. This is because of their extreme toxicity at low concentrations, their long-time stability, and their wide promotion for insect control. Their toxicity may be equalled or exceeded by some of the organic phosphates, but these chemicals lose potency relatively soon.

When aldrin is applied at the rate of one pound per acre, one square foot of ground surface will contain enough chemical to kill 2 adult quail, 20 young quail (2 weeks old), or 5 young pheasants, if it is all eaten. When dieldrin was fed to adult pheasants in very small quantities-- one two-hundred-thousandth of an ounce per day-- for a two-month period, they produced eggs of reduced hatchability and chicks subject to a high death rate.

Q. How do herbicides and fungicides affect wildlife?

A. There is little danger of direct poisoning of animals by present-day use of most herbicides and fungicides. There are only a few dangerous materials, such as the dinitro compounds, and generally these are not used in large amounts in wildlife areas. Sodium arsenite, commonly used for debarking in forest areas, is toxic to wildlife, but hazards and necessary precautions are well understood. A few herbicides are very toxic to fish. In addition to the dinitro compounds, both the chlorinated benzenes and the aromatic solvents should be used with extreme caution where safety of fish is a consideration. A number of fungicides and herbicides are repellent to certain animals, which reduces the possibility of poisoning.

The greatest danger of herbicides to wildlife lies in their effects on food and cover plants. Depending upon how they are applied, they may or may not destroy wildlife habitat and have even been used to improve it. Herbicidal programs should be planned with the same care as insecticidal programs and some of the same rules apply. The most specific treatment is generally best, for great damage can be done by ill-considered blanket treatments. Proper choice and use of herbicides require much knowledge; technical advice should be obtained before large-scale herbicidal programs are begun.

Q. Do most animals react similarly to pesticides?

A. No. There is a great difference in response, even among insects. That is why it is important to be selective in choice of a pesticide. The fact that insects often react differently from birds and mammals also can be used to advantage. Mammals and birds respond in a roughly similar way, although there are some differences between kinds. Fish and other cold-blooded animals are closer to insects in their response, and are generally the most sensitive to insect-control agents.

Q. What authority does government have to spray insecticides on private land?

A. Most states have laws concerning use of pesticides. Some are strict and some are liberal. State and municipal operations are conducted under these laws. Federal operations are carried on in cooperation with the states and in strict accordance with state laws and local ordinances.

Q. What is government doing to safeguard wildlife from pesticides?

A. Conservation departments in some states are concerned with the effect of pesticides on wildlife and have worked closely with operating and control agencies to minimize wildlife damage. Some states have sponsored worthwhile research programs. Others have not yet become actively concerned with the problem.

The federal government, through the Bureau of Sport Fisheries and Wildlife of the Fish and Wildlife Service, has conducted research on pesticides and has cooperated with state and federal agencies on the problem since 1944. The program has been limited by finances, but it is hoped that research can be increased and that safer methods of pest control can be developed.

The Federal Insecticide, Fungicide, and Rodenticide Act prescribes definite rules concerning registration and labeling of pesticides. Among these rules is the requirement that, when deemed appropriate by the Department of Agriculture, a warning appear on the label to prevent injury to fish and wildlife. This precaution has been applied to five insecticides-- toxaphene, aldrin, dieldrin, endrin and malathion-- when used in aquatic areas.

Q. What is industry doing to safeguard wildlife from the effects of pesticides?

A. A few industrial concerns have taken a most responsible attitude; they have worked cooperatively with state and federal agencies and have hired research personnel of their own to conduct tests on overall biological effects.

Others, unfortunately, feel they have no responsibility beyond the manufacture and sale of chemicals.

Q. What can individuals or groups do to help prevent wildlife damage by pesticides?

A. Their interest in the welfare of wildlife can be shown by discussing plans and programs with personnel in charge of control operations. They can urge that pesticidal programs conform to the principles listed on pages 3 and 4. They can arrange to have careful, objective observations made of the effects on wildlife and they can present documented, factual reports to authorities in charge. They can work for suitable legislation in states lacking protective measures. They can urge evaluation of wildlife effects by competent biologists before programs are begun, and follow-up studies during and after pesticidal treatments.

Q. How do mosquito control programs affect wildlife?

A. Many mosquito control programs are in operation, sponsored by both public and private groups. Chemical application rates are usually low enough to prevent damage to warm-blooded animals, but high enough to be somewhat hazardous to aquatic animals. Mosquitoes have become resistant to the treatments, and the natural tendency to increase dosages and to use stronger chemicals is a danger to animal life. Because of the problem of mosquito resistance, chemical treatments have been completely abandoned in some areas, and control has reverted to programs of ditching and filling. These programs reduce danger to fish, but may increase danger to wildlife, particularly waterfowl, through habitat destruction.

Recent research has shown that, in some areas, controlled flooding can limit mosquito numbers and, at the same time, improve habitat for waterfowl.

Q. What are the gypsy moth and spruce budworm control programs? Do they endanger wildlife significantly?

A. They are cooperative programs of the U. S. Department of Agriculture and the individual states.

The gypsy moth program is a campaign of eradication. Gypsy moths are distributed over 38 million acres in nine states. About one million acres of its range were treated in 1956. Nearly three million acres were treated in New Jersey, Pennsylvania, and New York in 1957. DDT is applied as an aerial spray at the rate of one pound in one gallon of fuel oil per acre. A single treatment in spring or early summer, while the larvae are active, is expected to exterminate the insect. This program should be relatively harmless to warm-blooded animals, to judge from results of scientific field studies. There is more danger to fish and aquatic invertebrates if sprays reach water areas. Dangers of secondary effects owing to depletion of food supplies over large areas cannot be assessed at present.

The spruce budworm ranges throughout the coniferous forest zone and attacks fir, spruce, and other conifers. Outbreaks in Canada, Maine, and several western states have caused control efforts to be concentrated in these areas. DDT is applied at rates varying from one-half to one pound in one gallon of fuel oil per acre. In 1956, 1.3 million acres were treated in the United States. A die-off of fish in the Yellowstone River in 1955 resulted in the assignment of biologists to the program in 1956 and 1957. Studies are also underway in New Brunswick, Canada, where extensive losses of young salmon have occurred after spraying.

Q. What is the imported fire ant eradication program? How dangerous is it to wildlife?

A. Imported fire ants are distributed over 20 million acres throughout the southeastern states. They have been present in this country for about 40 years and have become a serious pest.

The Department of Agriculture now has authorization for a cooperative program with the states to exterminate this pest. The agencies plan to use both airplane and ground equipment to treat large areas with granular heptachlor or dieldrin, at the rate of two pounds per acre. To judge from research already done on the effects of these chemicals on wildlife, their use at the planned dosages presents a serious threat. Extent of the damage cannot be fully assessed in advance. It is known that birds and mammals are sensitive to the chemicals, and that fish, amphibians, and reptiles are even more seriously affected by them. Ground-living forms probably will be most vulnerable since the intent is to poison the soil. Residual effects are expected to persist for three years. In addition to direct mortality, animals may be adversely affected by destruction of their food supply.

Q. How dangerous to birds is DDT spraying for control of Dutch elm disease?

A. Dutch elm disease is caused by an introduced fungus that is carried by two species of bark beetles. The control program is an indirect one, aimed at the beetles. No effective way is known to kill the fungus directly.

Two treatments with DDT emulsion have been recommended. The first treatment consists of 2-4.8 pounds of DDT for an average 50-foot elm. Trees are sprayed in the late fall, winter, or early spring after leaves have dropped but before new flowers or leaves appear. The second treatment, in July, consists of half this amount of DDT per tree.

Spraying for Dutch elm disease control has caused moderate to fairly heavy losses of song birds when the DDT was applied during the peak of the spring migration and during the nesting season.

Losses can be reduced greatly by following the principles on pages 3 and 4, particularly numbers 7, 8, and 9. These latter rules have been endorsed by the U. S. Forest Service. The Forest Service also points out that (1) methoxychlor may be substituted for DDT and is much safer for birds and mammals, and (2) the July treatment probably helps very little in disease control. Instead it may destroy beneficial insects and result in abnormal outbreaks of other pests such as scales, mites, and aphids.

Q. What is the Mediterranean fruit fly program? Does it endanger wildlife significantly?

A. In 1956, the Mediterranean fruit fly was found widely dispersed in Florida. The Department of Agriculture, cooperating with the State of Florida, treated more than 750,000 acres that year in an attempt to eradicate the insect. Much of the area was treated more than once, making a total of 5.8 million acres. Malathion was applied by airplane in a yeast bait spray at the rate of one-half pound of malathion per acre. In addition, granulated dieldrin and granulated heptachlor were applied by hand under trees and bushes at the rate of five pounds per acre. The area of infestation was greatly reduced by the treatments. Malathion is safer for warm-blooded animals than is DDT but apparently is more dangerous to fish. Dieldrin and heptachlor are potentially very dangerous to wildlife.

Q. Are other large-scale pesticidal programs now in progress or contemplated?

A. The white-fringed beetle is now under quarantine in the southeastern states. Control is conducted by individuals or groups under supervision of federal and state personnel. Recommended insecticides for non-cultivated land are 3-5 pounds of dieldrin or 25 pounds of DDT per acre. Both treatments present serious dangers to wildlife.

Other extensive control programs include operations against Japanese beetles, cotton insects, corn insects, grasshoppers, and Mormon crickets.

Q. Is specific information available on the effect of the various pesticides on fish and wildlife?

A. For some species, and some pesticides, good information is available. For others, information is sketchy or lacking. The following references contain much detailed information. For help in specific problems or for guidance in establishing programs of pest control, apply to federal or state control agencies and conservation agencies.

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December 1957